World Journal of Advanced Research and Reviews

eISSN: 2581-9615 CODEN (USA): WJARAI

Cross Ref DOI: 10.30574/wjarr

Journal homepage: https://wjarr.com/

(Research Article)

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Physico-chemical and nutritional characteristics of 12 varieties of cassava (Manihot esculenta Crantz, 1766) grown in the Republic of Guinea

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World Journal of Advanced Research and Reviews, 2024, 23(03), 814–821

Publication history: Received on 22 July 2024; revised on 29 August 2024; accepted on 31 August 2024

Article DOI: https://doi.org/10.30574/wjarr.2024.23.3.2599

Abstract

Cassava is a distinctive contributor to food security and a source of income for smallholder farmers. Despite the importance of this agricultural product, very little data is available in Guinea, especially concerning the varieties grown and their nutritional composition.

The aim of this research was to study the physico-chemical and nutritional characteristics of 12 varieties of cassava grown in Guinea with a view to selecting varieties that could be used to produce a <<Gari>> of better quality.

Cassava tubers were collected in 6 regions in Guinea. The physico-chemical analyses were carried out on the pH and moisture content of the cassava paste from each of the 12 varieties, while the nutritional quality was determined on the basis of the composition of the varieties in carbohydrates, proteins, lipids and minerals.

In general, pH values ranged from 6.29 to 7.29 while moisture levels ranged from 51.64% to 58.94%. In addition, all the varieties analysed were those rich in carbohydrates (with levels between 42.36% and 51.17%) but low in fat (values between 0.30% and 3.56%). On the other hand, three varieties, namely Farawoulen, Konko and Samouya, are the richest in protein with values of 8.05%, 5.48% and 4.23% respectively.

In short, these cassava varieties produced in Guinea could be used, taking into account their biochemical composition, in future gari production work.

Keywords: Characteristic; Morphological; Physico-chemical; Cassava; Guinea

1. Introduction

Cassava (Manihot esculenta) is produced in more than 100 countries around the world [1]. It is an accessible source of carbohydrates for about 800 million people in Africa; Asia; and Latin America. It is a starchy root plant dispersed by cloning; considered a food security or insurance crop for smallholder farmers due to its year-round availability and ability to grow in marginal environments characterized by water mills and poor soils [2].

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Cassava is the fourth largest food product in the world. With production increasing from 71.3 million tonnes in 1961 to 302.7 million tonnes in 2020 [3; 4].

In the Republic of Guinea; according to data provided by the National Agency for Agricultural and Food Statistics (ANASA) from data from the 2022/2023 seasons; rear projections (East) and the 2021 National Census of Agriculture and Livestock (RNAE) database; national cassava production has almost doubled in eight years. National production increased from 1; 334;701 tons in 2015 to 2; 815;628 tons in 2023 and cultivated areas from 171;168 to 180;365 hectares. Cassava is the second largest agricultural production in the country after rice (with 3;158;141 tonnes) in 2023 [5].

It was originally referred to as a food supply during famine because it was a more reliable source of food during periods of drought. And it has been proven to be both a staple food and an industrial-scale cash crop in the global economy like cotton; coffee; oil palm; etc [6 ; 7]. Cassava root has several uses [8]

In West Africa; cassava root is used in various artisanal and industrial forms for human food; and is also used for livestock feed. Several products from cassava are marketed; including gari; attiéké; chips; starch; tapioca; fufu; raw flour; etc. [8]. Some studies have reported that cassava varieties include two main groups; sweet and bitter varieties. Sweet varieties are used by hand for human consumption; while bitter varieties undergo post-harvest processing before consumption [9]. And this varietal distribution is largely based on the level of cyanogenic glucosides present in plant tissues [10; 11 ; 12]. Manano et al. (2017) reported in 2017 that post-harvest treatments such as fermentation and drying significantly decrease the amount of cyanide [13].

It should also be noted that the diversification of cultivated species and varieties makes it possible to limit the impact of pathogens and crop pests [14; 15; 16]. ; According to N'Djadi in 2017; the use of the right varieties; the right agricultural techniques as well as the integrated management of soil fertility and the planting of crops in the right place are essential to maintain sustainable and satisfactory production [17; 18]. Raw cassava root contains more carbohydrates than potatoes and fewer carbohydrates than wheat; rice; yellow maize and sorghum on a 100 g basis [19; 20].

In Guinea; Manihot esculenta called edible cassava is the most popular. It is cultivated in all regions and prefectures of the country [21].

As the post-harvest lifespan of cassava is a consideration; different processing technologies are used depending on the region; food customs and products to be obtained. Processing the cassava root improves its digestibility; palatability; stability of the derived products; increases their shelf life and reduces their cyanogenic compound content [22]. The techniques are varied and involve a combination of multiple methods including peeling; washing; cutting; soaking; grinding; grating; drying; cooking and fermentation; etc. [22]. However; in Guinea; very few processing systems are in place to limit post-harvest losses of this highly perishable commodity. The objective of this study was to determine the physico-chemical characteristics of the most widely grown cassava varieties in the Republic of Guinea; with a view to their transformation into gari.

2. Methodology

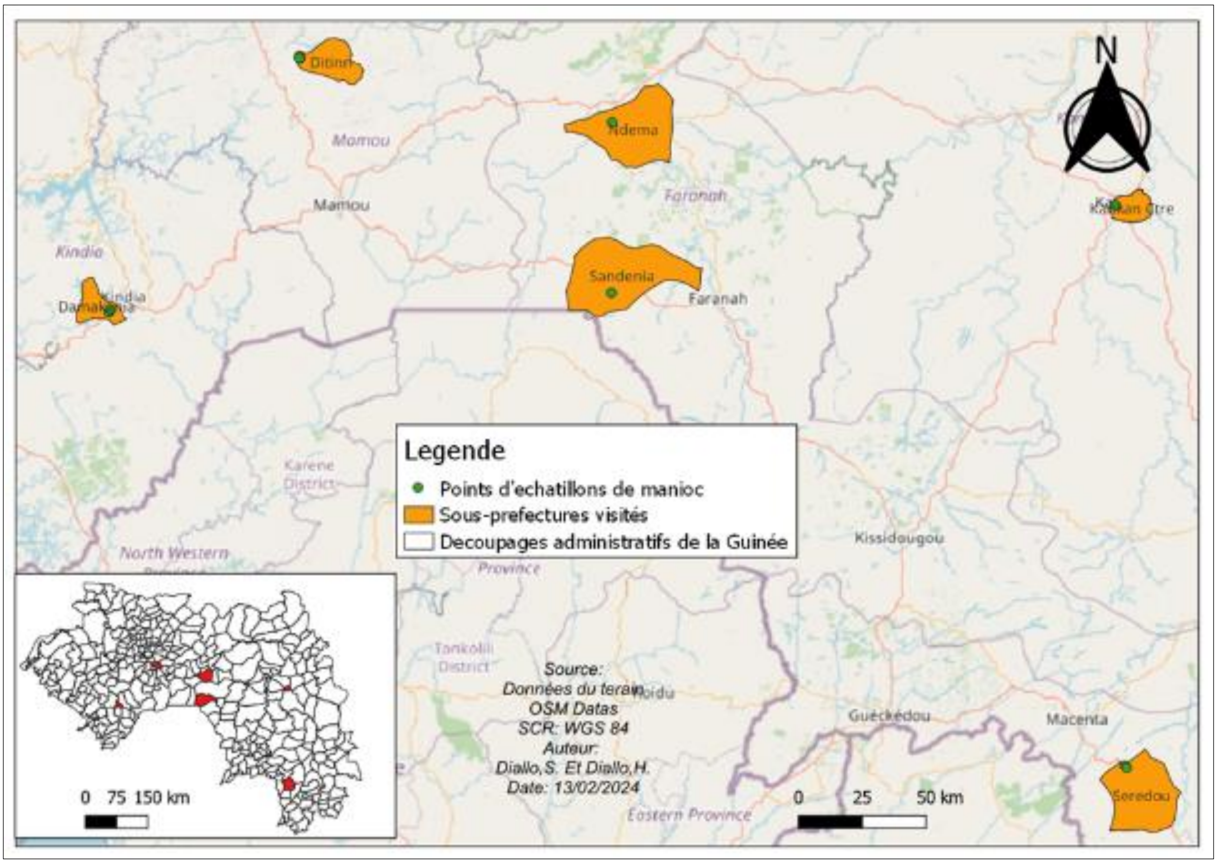
2.1. Study Environments and Sampling

This study was carried out in the Republic of Guinea, which is located in West Africa and covers an area of 245,857 km2. It is bordered to the west by the Atlantic Ocean and shares its borders with six other countries: Guinea-Bissau to the northwest, Senegal to the north, Mali to the north and northeast, Côte d'Ivoire to the east, and Liberia and Sierra Leone to the south. It is a coastal country with 300 km of coastline on the Atlantic [23]. Nine (9) prefectures located in the four natural regions of the country known for their very high cassava production were targeted and visited.

2.2. Working Method

This is a prospective, descriptive and analytical longitudinal study lasting four months that took place from November 11, 2022 to March 3, 2023. A survey was conducted at the CRRAF (Regional Center for Agricultural Research of Foulayah), the National Service for Rural Promotion and Agricultural Advisory (SENPROCA) of Dalaba and a collaboration with the wave Africa 2022-2023 survey coordinated by the Institute of Agricultural Research of Guinea (IRAG).

Twenty-five (25) districts located in the prefectures of Dalaba, Dabola, Faranah, Forécariah, Kankan, Kindia, Macenta, Mandiana and N'Zérékoré were visited during this study. And the analysis of the results of the survey conducted made it possible to identify 20 varieties of cassava. And finally, targeted sampling of cassava varieties with a representativeness rate greater than or equal to 4% in all the varieties identified was applied. The samples were analyzed at the laboratory of the National Office of Quality Control (ONCQ) located in the municipality of Matoto.



Legende : Cassava sampling point ; Sub-prefectures ; Administrative division of Guinea.

Figure 1 Areas of origin of the 12 varieties of cassava

2.3. Study variables

Our variables were the analysis of the physicochemical parameters of cassava tubers: on the determination of moisture content, crude protein, fat, total ash, total carbohydrate and the measurement of pH according to the methods described by AOAC (1990; 1995), and FAO (1998).

- pH determination: pH was determined according to the potentiometric method of AOAC (1990) using the electrode of a pH meter. 5 g of the cassava paste was weighed and added to 10ml of distilled water in a beaker, then the end of the electrode of the HANNA pH meter was immersed in the solution and the pH value is instantly displayed on the screen.
- Determination of moisture: The method described by AOAC (1995) was adopted, where the fresh samples weighed were dried in an air oven (Memmet, UFE-600), at 105ºC to a constant weight. The percentage of moisture content was calculated as the difference between fresh and dry weights.
- Determination of total ash: The ash content was determined by the drying method described by AOAC (1995) where the weighed sample was heated to 550ºC for 5 hours to ensure proper incineration. The percentage of ash content was calculated.
- Crude protein determination: The nitrogen and crude protein assay method was done using the Micro Kjeldahl method (AOAC, 1995). The sample was digested using sulfuric acid and a mixed catalyst (96% $CuSO_4$ + 3.5% Na_2SO_4, 0.5% selenium oxide) in the digestion apparatus (Kjeltec System HT 2, Foss tecator, Hoganäs, Sweden). The distillate, trapped in a boric acid solution, was titrated to 0.1 M HCl using a mixture of methyl blue and methyl red as indicators to obtain total nitrogen. Crude protein content was calculated using a correction factor of 6.25.

- Determination of lipids: Cassava flour was extracted using petroleum ether in a Sohxlet extraction unit (Soxtec system, Hoganäs, Sweden), according to the method described by AOAC (1995).
- Determination of total carbohydrates: The total carbohydrate content was calculated by difference. For this reason, the other constituents in the food, namely lipids, proteins, ashes, are determined separately, added and subtracted from the total weight of the food. The determination of the total carbohydrate content was obtained by the FAO formula (1998).

2.4. Means of data collection and processing:

Our data were collected through survey sheets and laboratory analyses, then entered into the Excel 2013 software and analyzed on the SPSS statistical version 26 software on the descriptive analysis and the representation of the results by diagrams.

3. Results and discussion

In this study, several local and exotic cassava varieties with different names from one locality to another were identified among cassava producers. Most of the names were vernacular names based on the physical observation of the stems, leaves and tubers or by the name of the person who first transported the cuttings to the locality.

3.1. Physicochemical parameters of the 12 cassava varieties analysed

A good yield of cassava tubers in various products is a determining factor in the choice of varieties. Dry matter is an indicator of tuber yield. The results of the physical parameters (dry matter, moisture and total centre) of the samples can be found in Table 1.

Table 1 Representation of the means and standard deviations of the dry matter, moisture and ash levels

Samples	*Dry matter(%)*	*Moisture(%)*	*Ash(%)*
BBD	46.80 ± 0.04**	53.20 ± 0,04**	2.22 ± 0.03
BK	48.36 ± 0.36***	51.64± 0.36	1.10 ± 0.04**
CCF	46.77 ± 0.07**	53.23 ± 0.08**	1.06 ± 0.08**
KS	41.86 ± 0.21*	58.14 ± 0.21***	0.88 ± 0.03*
FK	44.32 ± 0.22	55.68 ± 0.22	3.72 ± 0.15***
IITA 23-24	42.87 ± 0.11*	57.13 ± 0.11***	0.35 ± 0.07*
KKD	41.06 ± 0.06*	58.94 ± 0.06***	3.28 ± 0.22***
MBZ	42.35 ± 0.03*	57.65 ± 0.03***	0.22 ± 0.06*
MRZ	42.33 ± 0.03*	57.67 ± 0.03***	0.91 ±0.12*
SD	46.23 ± 0.03**	53.77 ± 0.03**	1.47 ± 0.11**
TK	42 .43 ± 0.08*	57.57 ± 0.08***	0.41 ± 0.02*
TME419	47.07 ±0.20***	52.93 ± 0.20**	0.16 ± 0.03*

Legend: BBD = Bantara Bodhé; **BK** = Banankougbé ; **CCF** = Couscous ; **KS**= Karossabany ; **FK** = farawoulen ; **KKD** = Konko; **MBZ**= Manioc Blanc ; **MRZ** = Manioc Rouge ; **SD** = Samouya ; **TK**= Tokoumbo.

Values with the same number of exponents in the row are not significantly different from each other.

After performing the non-parametric Kruskal-Wallis test, we found that the P-Value value is 0.001 and we conclude that the comparison of the means of dry matter rate, center rate and moisture content from one sample to another was significantly different.

All varieties in general had a high dry matter content (>40%). The varieties Banankougbé, TME419, Bantara Bodhé, Couccous and Samouya had exceptional potential in tuber processing, with respectively: 48.36±0.36%; 47.07±0.20%; 46.80±0.04%; 46.77±0.07%; 46.23±0.03% of dry matter rates.

In terms of ash content, the Farawoulen and Konko varieties had remarkable values with 3.72 ± 0.17% and 3.28 ± 0.22%, respectively. In terms of moisture content, the maximum value was that of the Konko variety with 58.94 ± 0.06% and the minimum value was that of the Banankougbé variety with 51.64 ± 0.036%.

Our results are comparable to those of Sanoussi et al in 2015[8], who found 43.15±0.26%; 42.34 ± 0.42% and 44.67±0.12% of dry matter rates on three most widely grown cassava varieties in Benin. And they reported from Megnanou, 2009 [24], that a high dry matter content of cassava roots could lead to an increase in the yield and texture of the derived products.

In terms of ash rates, they are similar to those of Afoakwa and al, 2012 [20], who found values between 1.17 ± 0.16% and 2.34 ± 0.15% in six cassava varieties (four improved and two traditional) grown in Ghana.

Table 2 Representation of the descriptive pH analysis of cassava samples

	N	Minimum	Maximum	Moyenne	Ecart type
pH	12	6.29	7.29	6.728	.268
N valide (liste)	12				

This table shows that the pH of the samples analyzed were around 7 and therefore tends towards neutrality.

3.2. Nutrient characteristics of the cassava varieties tested

The root is generally a physiological energy reserve with a high carbohydrate content, which varies from 80% to 90% in dry matter but low in protein and lipids with 1 to 3% and 0.1% to 0.65% respectively on a dry matter basis (Buitrago, 1990; Charles and al, 2005; Padonou and al, 2005; Montagnac, 2009; Zvinavashe and al, 2011 ; d'Afoakwa and al, 2012) [25; 26; 27; 19; 20 and 28]. The results of these parameters of our samples can be found in Figures 2 and 3 in the form of a diagram.

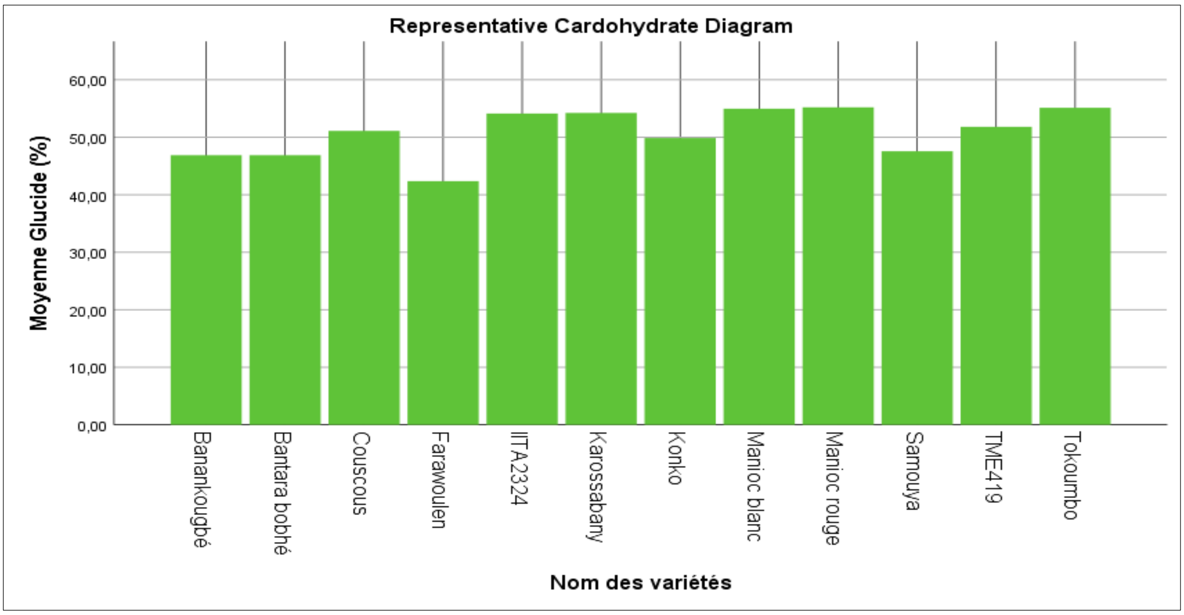


Figure 2 Representation of the total carbohydrate content of cassava samples

It can be seen from this figure that the varieties Red Cassava (Manioc rouge), Tokombo, White Cassava (Manioc blanc), Karossabani and IITA23-24 had carbohydrate levels above 54% and the lowest level was 42.869% of the Farawoulen variety. With an average of 50.84 and a standard deviation of 4.416.

These results are different from Manano and al in 2018 [13], who found 85.27±1.20b, 85.83±0.43b, 83.86±0.91, 91.33±0.47 and 87.87±0.37 of total carbohydrates on five samples of cassava varieties grown in Uganda. And similar to those of Sanoussi et al, in 2015[8], who had found results on three varieties of cassava most cultivated in Benné, namely 40.20%; 39.46% and 41.13% of total carbohydrates.

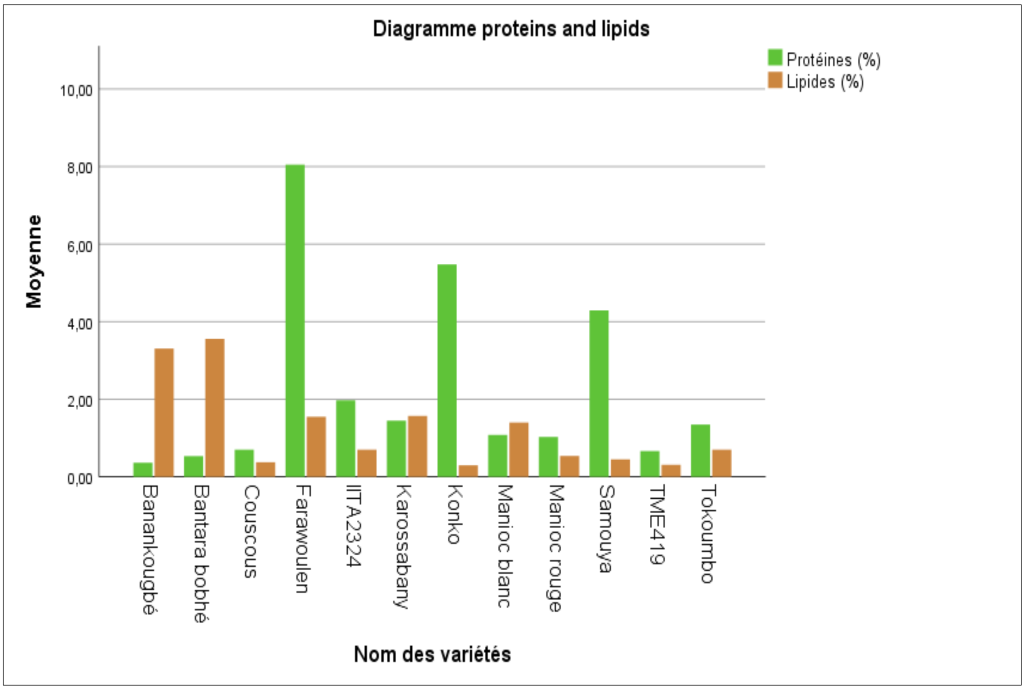


Figure 3 Representation of protein and lipid levels of cassava samples

This figure shows that cassava roots are generally low in protein and fat. Three varieties Farawoulen, Konko and Samouya stood out from the others with 8.05% respectively; 5.48% and 4.23% of crude proteins and two others in lipids with 3.56% and 3.31% for the Bantara Bodhé and Banankougbé varieties. The difference in protein and lipid content of cassava roots may be due to the genotype of the varieties rather than the environment from which they originate.

These results are similar to those found by Manano and al [13] on five cassava varieties with values between 0.74% and 1.52% of crude protein and between 0.39% and 0.63% of fat. And also those of Afoakwa and al [20] who had found protein contents between 1.17 and 3.48% on six varieties of cassava grown in Ghana.

4. Conclusion

The study shows that several varieties of exotic and local cassava grown in the Republic of Guinea. With names that differed from one locality to another; most of which were vernacular names based on the physical observation of the stems; leaves and tubers of cassava or by the name of the one who first transported the cuttings to the locality. Twelve varieties were grown in almost every region of the country and had appreciable levels of total carbohydrate and dry matter yields. The varieties Banankougbé; TME419; BantaraBodhé; Couscous and Samou-ya had more than 45% dry matter content and therefore more potential in the processing of cassava tubers. The study also shows that cassava is not a major source of protein and fat in the human diet. But some varieties made exceptions due to their genotypes.

Thanks

The authors thank the Ministry of Scientific Education and Innovation; the cooperation of the staff and managers of IRAG; ONCQ and cassava producers in the districts visited.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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